

amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE"

Invention

The invention is directed to active water compatible actinic radiation curable compositions containing maleimide derivatives, water compatible resins and water, which are capable of curing under actinic radiation. The invention is also a method for curing such a composition in the absence of photoinitiator and a method for controlling the rate of cure for such compositions.

Restriction Requirement

As indicated by the Examiner and based on a telephone conversation with Applicants' Attorney on 9/27/02, the Applicants elect to prosecute, with traverse, the claims of Group 1 (Claims 1-19) of the pending patent application. The claims of Groups 2 to 4 (Claims 20-29 collectively) have all been withdrawn by the Examiner as being drawn to a non-elected invention.

Rejections Under 35 U.S.C. § 112, 1st Paragraph

Claims 1-19 (erroneously cited by the Examiner as "Claims 1-29") have been rejected under U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such away as to enable one skilled in the art to which it pertains, or which it is most nearly connected, to make and/or use the invention. More specifically:

First, the Examiner opines that the claims recite a "water compatible compound", which in itself, is so broad as to be incomprehensible. Applicants point out that the phrase "water compatible" as used herein, describes compounds that are partially or substantially water dilutable, water soluble and/or capable of forming a water emulsion or dispersion with the energy curable composition herein; see page 40, lines 35 to 38 of Applicants' specification. In the case where the energy curable compositions are used to formulate coatings, it is preferred that the particular water compatible compound **be compatible**

with both the water and maleimide derivates in order to avoid any phase separation or precipitation of one or more of the components; see page 41, lines 5 to 14 of Applicants' specification. Therefore, as the phrase has been defined in Applicants' specification, which serves as an index to the claims, Applicants kindly ask that the rejection be withdrawn.

Secondly, the Examiner opines that the recitation of "a compound copolymerizable with the said maleimide derivative" in Claim 3 renders the claim, and any dependent claim thereon, as non-enabling since the identities of the maleimide derivatives" would necessarily have to be obtained first, with subsequent experimentation to determine exactly what compounds may then be "copolymerizable therewith". Applicants kindly point out that one of ordinary skill in the art, given the written description and content of Applicants' specification, namely pages 22 to 40, would indeed be able to determine what compounds would be copolymerizable with the maleimide derivatives without undue experimentation. Therefore, Applicants kindly ask that the rejection be withdrawn.

Rejections Under 35 U.S.C. § 112, 2nd Paragraph

Claims 1-19 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out the subject matter, which the applicant regards as the invention on numerous grounds. More specifically:

First, the Examiner states that "water compatible compound" fails to point out the subject matter that applicants intend to claim. As pointed out above in addressing a similar rejection under 35 U.S.C. Section 112 First Paragraph, Applicants' specification at page 41 states "it is preferred that the particular water compatible compound be compatible with both the water and maleimide derivates in order to avoid any phase separation or precipitation of one or more

of the components.” Therefore, Applicants have in fact defined a “water compatible compound” and kindly ask that the rejection be withdrawn.

Secondly, Examiner states that Claim 3 has been rejected as the recitation of “a compound copolymerizable with the said maleimide derivative” renders the claim vague since the derivative compound must first be obtained in order to determine what maybe “copolymerizable therewith”. As pointed out above in addressing a similar rejection under 35 U.S.C. Section 112 First Paragraph, Applicants’ specification at pages 22 to 20 provides sufficient content for one of ordinary skill in the art to be able to determine what compounds would be copolymerizable with the maleimide derivatives without undue experimentation. Applicants kindly ask that rejection be withdrawn.

Thirdly, the Examiner opines that the recitation of “energy curable” in Claim 1 is not clear as to its proper meets and bounds. However, Applicants’ specification clearly and unequivocally states: “The active energy curable composition of the present invention forms a cured film without a photoinitiator under irradiation of light”. Further, an example of the energy curing conditions employed by Applicants’ under the present invention is provided. See page 47, lines 20 to 38 and page 48, lines 5 to 9 of Applicants’ specification. Applicants kindly ask that rejection be withdrawn.

Finally, Examiner opines that the phrase “such as” in Claims 2 and 12 renders those claims indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention. Applicants have amended Claims 2 and 12 by removing the phrase and the wording following same (i.e. removed -- “such as ethylene vinyl alcohol and ethylene vinyl alcohol” and “such as ethylene vinyl alcohol copolymer”). Applicants kindly ask that rejection be withdrawn.

Rejections Under 35 U.S.C. § 102(a)

Claims 1-19 have been rejected Under 35 U.S.C. §102(a) as being clearly anticipated by **Sakurai et al.** (U.S. 6,410,611 B1). Sakurai et al. disclose the manufacture of an irradiation curable coating containing a bis-maleimide compound and water compatible compound, identical to those herein claimed. However, the Examiner opines that Sakurai et al.'s. composition may also contain water. Applicants point out that Sakurai et al does not disclose an actinic radiation curable composition that contains water. While Sakurai et al. use the word "water" a total of six times in the specification, in every instance, the water is involved in the synthesis of the bis-maleimide compound and not a component of Sakurai et al.'s energy curable composition; see for example Column 10, lines 3,5 and 57; Column 25, lines 53 and 58; and Column 27, line 29 of Sakurai et al. By contrast, water is an essential element of Applicants' actinic radiation curable composition. In view of the foregoing, Applicants' respectfully submit that Sakurai et al. do not anticipate Applicants' claims and therefore ask that the rejection be withdrawn.

Rejections Under 35 U.S.C. § 102(b)

Claims 1-3 have been rejected under 35 U.S.C 102(b) as being clearly anticipated by **McGinnis** (U.S. 4,066,523). McGinnis discloses an electrocoating composition containing a maleimide compound, water and a water dispersed polymer. However, the Examiner opines that McGinnis literally teaches or discloses that the composition is cured by actinic radiation alone. Applicants point out that the compositions in McGinnis undergo dual cure in his cathodic electro coating system whereby **both** heat and ultraviolet radiation are required to cure the composition. Applicants' actinic radiation curable composition simply requires the use of actinic radiation as the curing means and does not require any additional curing means such as heat to cure the composition. Since McGinnis discloses a "dual cure" system requiring both heat and ultraviolet

radiation McGinnis does not anticipate Applicants claims. Applicants kindly ask that the rejection be withdrawn.

Claims 1-3 have been rejected under 35 U.S.C 102(b) as being clearly anticipated by **Roth et al.** (U.S. 4,626,497). Roth et al disclose a process for producing colored photographic polymer images using photocrosslinked copolymers. However, the Examiner opines that Roth et al. teach the inclusion of water with a maleimide derivative and water compatible compound, as herein claimed. Applicants point out that Roth et al. disclose a process where water is used simply to develop and wash a photocrosslinked copolymer after it has already been cured by radiation. Therefore, Roth et al.'s maleimide functional (meth)acrylamide or vinyl ether copolymer composition is cured in the absence of water. In Roth et al. water is not a component of the curable composition; see Examples 37 to 43 of Roth et al. Roth et al. also disclose that water is used in the polymerization of the maleimide copolymer; see Examples 22 and 27 of Roth et al. Water is also employed by Roth et al. in the subsequent coating step for the copolymer onto a polyester base; see Example 36 of Roth et al. In no case is water recited as a component of Roth et al.'s curable composition. By contrast, water is an essential component of Applicants' actinic radiation curable composition and is present before the composition is cured. This being the case, Roth et al. do not anticipate Applicants' claims and Applicants kindly ask that the rejection be withdrawn.

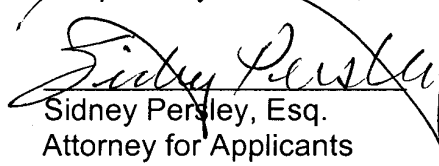
Claim 1 has been rejected under 35 U.S.C 102(b) as being clearly anticipated by **Wilson, Jr. et al.** (U.S. 5,034,279). Wilson, Jr. et al. disclose water compatible compositions containing resins and bis-maleimides. However, the Examiner opines that Wilson, Jr. et al. literally teach a composition curable by actinic radiation. Applicants submit that Wilson, Jr et al. disclose a water compatible coating composition that is heat cured or curable and not one that is actinic radiation curable. Applicants' active water compatible composition is

actinic radiation cured or curable. Therefore, Wilson Jr. et al. do not anticipate Applicants claims and Applicants kindly ask that the rejection be withdrawn.

Claim 1 has been rejected under 35 U.S.C 102(b) as being clearly anticipated by **Kishino et al.** (U.S. 5,993,687). Kishino et al. disclose an acrylonitrile solution of maleimide. However, the Examiner opines that Kishino et al. literally teach a composition curable by actinic radiation. Applicants point out that Kishino et al. do not disclose that their composition is curable by actinic radiation or by any other means. Therefore, Kishino et al. fail to disclose an actinic radiation curable composition which is an essential element of Applicants' claims. As a result Kishino et al. does not anticipate Applicants' claims and Applicants' kindly ask that the rejection be withdrawn.

Applicants believe that the amendments and remarks submitted herein, adequately and completely address the rejections raised by the Examiner. Accordingly, Applicants request allowance and issuance of the outstanding claims.

Respectfully submitted,


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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

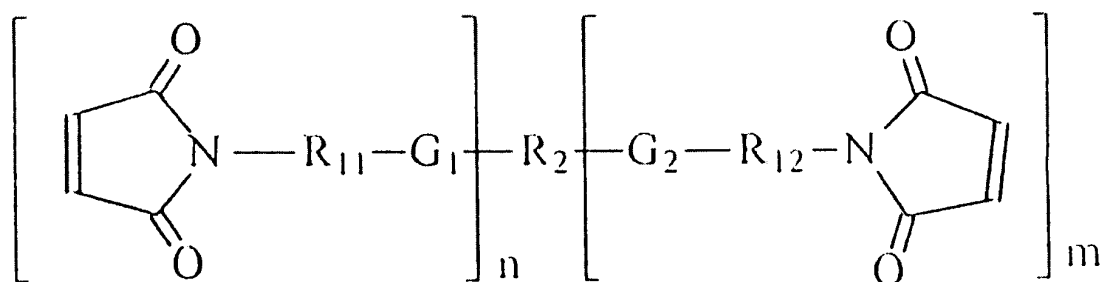
Please amend Claims 1 to 19 to read as follows:

1. **(Amended)** An active water compatible [energy] actinic radiation curable composition comprising a water compatible compound; a maleimide derivative; and water.
2. **(Amended)** The [energy] actinic radiation curable composition of Claim 1 wherein said water compatible compound is selected from the group consisting of acrylate resins; methacrylate resins; acrylic dispersions; urethane resins; vinyl alcohols such as ethylene vinyl alcohol and ethylene vinyl alcohol; vinyl alcohol copolymers such as ethylene vinyl alcohol copolymer; polysaccharides; polysucrose; and glucose.
3. **(Amended)** The [energy] actinic radiation curable composition of Claim 1 further comprising a compound copolymerizable with the said maleimide derivative and water compatible compound.
4. **(Amended)** The [energy] actinic radiation curable composition of Claim 3 wherein said copolymerizable compound [comprises] incorporates at least one compound selected from the group consisting of a compound having at least one group selected from an acryloyloxy group and methacryloyloxy group, and a compound having vinyl ether group.
5. **(Amended)** The [energy] actinic radiation curable composition of Claim 4 wherein said compound having at least one group selected from an acryloyloxy group and methacryloyloxy group [comprises] incorporates at least one compound selected from (poly)ester (meth)acrylate, urethane (meth)acrylate,

epoxy (meth)acrylate, (poly)ether (meth)acrylate, at least one compound selected from the group consisting of an alkyl (meth)acrylate having aromatic group, and a (meth)acrylate having alicyclic group.

6. (Amended) The [energy] actinic radiation curable composition of Claim 5 wherein said compound having vinyl ether group [comprises] incorporates at least one compound selected from the group consisting of an alkyl vinyl ether having a terminal group substituted with at least one selected from the group consisting of a hydrogen atom, a halogen atom, a hydroxyl group, and an amino group, a cycloalkyl vinyl ether having a terminal group substituted with at least one selected from the group consisting of a hydrogen atom, a halogen atom, a hydroxyl group, and an amino group, and at least one vinyl ether selected from the group consisting of a monovinyl ether, a divinyl ether, and a polyvinyl ether in which a vinyl ether group is connected with alkylene group; and in which a vinyl ether group is connected with at least one group with and without substituent selected from the group consisting of alkyl group, cycloalkyl group, and aromatic group, via at least one linkage selected from the group consisting of an ether linkage, and urethane linkage, and ester linkage.

7. (Amended) An active water compatible [energy] actinic radiation curable composition comprising a water compatible compound; water; and a maleimide derivative of the formula:



Wherein n and m each independently represent an integer of 1 to 5, and the total of m and n is 6 or smaller;

R_{11} and R_{12} each independently represent a linking group selected from the group consisting of an alkylene group, an alicyclic group, an arylalkylene group, and a cycloalkylalkylene group;

G_1 and G_2 each represent an ester linkage selected from the group consisting of $-\text{COO}-$ and $-\text{OCO}-$;

and R_2 represents a linking chain having an average molecular weight of 100 to 100,000 selected from the group consisting of a (poly)ether or (poly)ester linking chain, in which at least one organic group consists of a group or groups selected from a straight or branched chain alkylene group, an alkylene group having a hydroxyl group, an alicyclic group, an aryl group, an arylalkylene group, and a cycloalkylalkylene group connected via at least one linkage selected from the group consisting of an ether or ester linkage.

8. (Amended) The [energy] actinic radiation curable composition of Claim 7 wherein R_2 is a (poly)ether linking chain having an average molecular weight of 100 to 100,000, and [comprised of] incorporates repeating units containing at least one group selected from a $\text{C}_6\text{-C}_{24}$ aryl group.

9. (Amended) The [energy] actinic radiation curable composition of Claim 8 wherein R_2 [is comprised of] incorporates repeating units containing at least one group selected from a $\text{C}_2\text{-C}_{24}$ alkylene group having a hydroxyl group.

10. (Amended) The [energy] actinic radiation curable composition of Claim 7 wherein R_2 is a (poly)ester linking chain having an average molecular weight of 100 to 100,000, and [comprised of] incorporates repeating units containing at least one group selected from a $\text{C}_2\text{-C}_{24}$ straight or branched chain alkylene group, a $\text{C}_6\text{-C}_{24}$ alkylene group having a hydroxyl group, and $\text{C}_6\text{-C}_{24}$ aryl group.

11. (Amended) The [energy] actinic radiation curable composition of Claim 9 wherein R [is comprised of] incorporates repeating units containing at least one group selected from a C₂-C₂₄ straight or branched chain alkylene group or a C₂-C₂₄ alkylene group having a hydroxyl group.

12. (Amended) The [energy] actinic radiation curable composition of Claim 7 wherein said water compatible compound is selected from the group consisting of acrylate resins; methacrylate resins; acrylic dispersions; urethane resins; vinyl alcohols such as ethylene vinyl alcohol and ethylene vinyl alcohol; vinyl alcohol copolymers such as ethylene vinyl alcohol copolymer; polysaccharides; polysucrose; and glucose.

13. (Amended) The [energy] actinic radiation curable composition of Claim 7 wherein said water compatible compound is a resin selected from the group consisting of acrylate and urethane resins.

14. (Amended) The [energy] actinic radiation curable composition of Claim 13 wherein said acrylate resin is aliphatic epoxy acrylate.

15. (Amended) The [energy] actinic radiation curable composition of Claim 13 wherein said resin urethane resin is aliphatic urethane acrylate.

16. (Amended) The [energy] actinic radiation curable composition of Claim 7 further comprising a compound copolymerizable with the said maleimide derivative and water compatible compound.

17. (Amended) The [energy] actinic radiation curable composition of Claim 16 wherein said copolymerizable compound [comprises] incorporates at least one compound selected from the group consisting of a compound having at

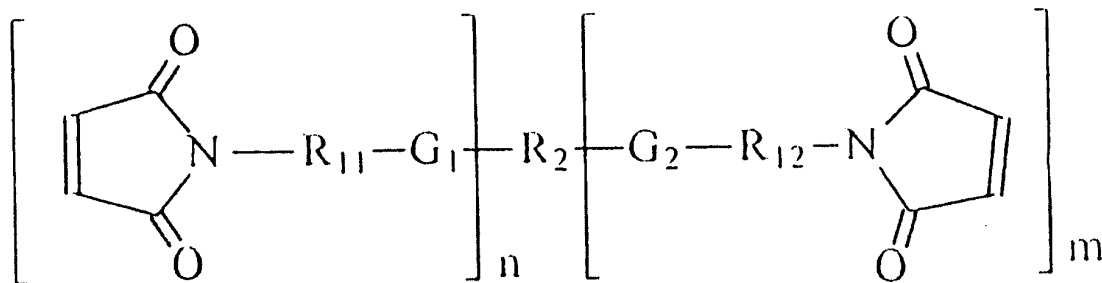
least one group selected from an acryloyloxy group and methacryloyloxy group, and a compound having vinyl ether group.

18. (Amended) The [energy] actinic radiation curable composition of Claim 17 wherein said compound having at least one group selected from an acryloyloxy group and methacryloyloxy group [comprises] incorporates at least one compound selected from (poly)ester (meth)acrylate, urethane (meth)acrylate, epoxy (meth)acrylate, (poly)ether (meth)acrylate, a (meth)acrylate having aromatic group, and a (meth)acrylate having alicyclic group.

19. (Amended) The [energy] actinic radiation curable composition of Claim 17 wherein said compound having vinyl ether group [comprises] incorporates at least one compound selected from the group consisting of an alkyl vinyl ether having a terminal group substituted with at least one selected from the group consisting of a hydrogen atom, a halogen atom, a hydroxyl group, and an amino group, a cycloalkyl vinyl ether having a terminal group substituted with at least one selected from the group consisting of a hydrogen atom, a halogen atom, a hydroxyl group, and an amino group, and at least one vinyl ether selected from the group consisting of a monovinyl ether, a divinyl ether, and a polyvinyl ether in which a vinyl ether group is connected with alkylene group; and in which a vinyl ether group is connected with at least one group with and without substituent selected from the group consisting of alkyl group, cycloalkyl group, and aromatic group, via at least one linkage selected from the group consisting of an ether linkage, an urethane linkage, and an ester linkage.

Please add new Claims 30 to 41 as follows:

30. (New) A method for controlling the cure rate of a water compatible actinic radiation curable composition containing a maleimide derivative and having the structure



wherein n and m each independently represent an integer of 1 to 5, the sum of m and n is 6 or smaller;

R_{11} and R_{12} each independently represent a linking group selected from the group consisting of an alkylene group, an alicyclic group, an arylalkylene group, and a cycloalkylalkylene group;

G_1 and G_2 each represent an ester linkage selected from the group consisting of $-\text{COO}-$ and $-\text{OCO}-$;

and R_2 represents a linking chain having an average molecular weight of 100 to 100,000 selected from the group consisting of a (poly)ether or (poly)ester linking chain, in which at least one organic group consists of a group or groups selected from a straight or branched chain alkylene group, an alkylene group having a hydroxyl group, an alicyclic group, an aryl group, an arylalkylene group, and a cycloalkylalkylene group connected via at least one linkage selected from the group consisting of an ether or ester linkage;

wherein said method comprises adjusting the molecular weight of R_2 to control the cure rate of the composition in the absence of a photoinitiator.

31 (New). The method of claim 30 wherein when the molecular weight of R_2 is increased so as to increase the cure rate of said water compatible actinic radiation curable composition containing a maleimide derivative.

32 (New). The method of claim 30 wherein when the molecular weight of R_2 is decreased so as to decrease the cure rate of said water compatible actinic radiation curable composition containing a maleimide derivatives.

33. (New) The method of claim 30 wherein R_2 linking chain has an average molecular weight of 100 to 100,000.

34. (New) The method of claim 30 wherein R_2 is selected from the group consisting of (poly)ether linking chains, (poly)ester linking chains and mixtures thereof, in which at least one organic group consists of a group or groups selected from a straight or branched chain alkylene group, an alkylene group having a hydroxyl group, an alicyclic group, an aryl group, an arylalkylene group, and a cycloalkylalkylene group connected via at least one linkage selected from the group consisting of an ether and ester linkage.

35. (New) The method of claim 34 wherein R_2 incorporates repeating units containing at least one group selected from a C_2 - C_{24} straight or branched chain alkylene group, a C_2 - C_{24} alkylene group having a hydroxyl group.

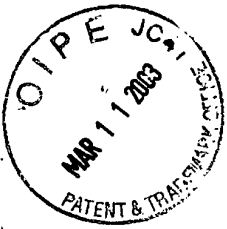
36. (New) The method of claim 35 wherein R_2 is a (poly)ester linking chain having an average molecular weight of 100 to 100,000 and incorporates repeating units containing at least one group selected from a C_2 - C_{24} straight or branched chain alkylene group, a C_2 - C_{24} alkylene group having a hydroxyl group and a C_6 - C_{24} aryl group.

37. (New) The method of claim 35 wherein R_2 is a (poly)ether linking chain having an average molecular weight of 100 to 100,000 and incorporates repeating units containing at least one group selected from a C_2 - C_{24} straight or branched chain alkylene group, a C_2 - C_{24} alkylene group having a hydroxyl group and a C_6 - C_{24} aryl group.

38. (New) The method of claim 37 wherein R_2 is polytetramethylene glycol or polyethylene glycol.

39. (New) The method of claim 38 wherein R_2 is a polytetramethylene glycol having an average molecular weight of 100 to 4000.

40. (New) The method of claim 39 wherein R_2 is a polyethylene glycol having an average molecular weight of 100 to 1000.



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